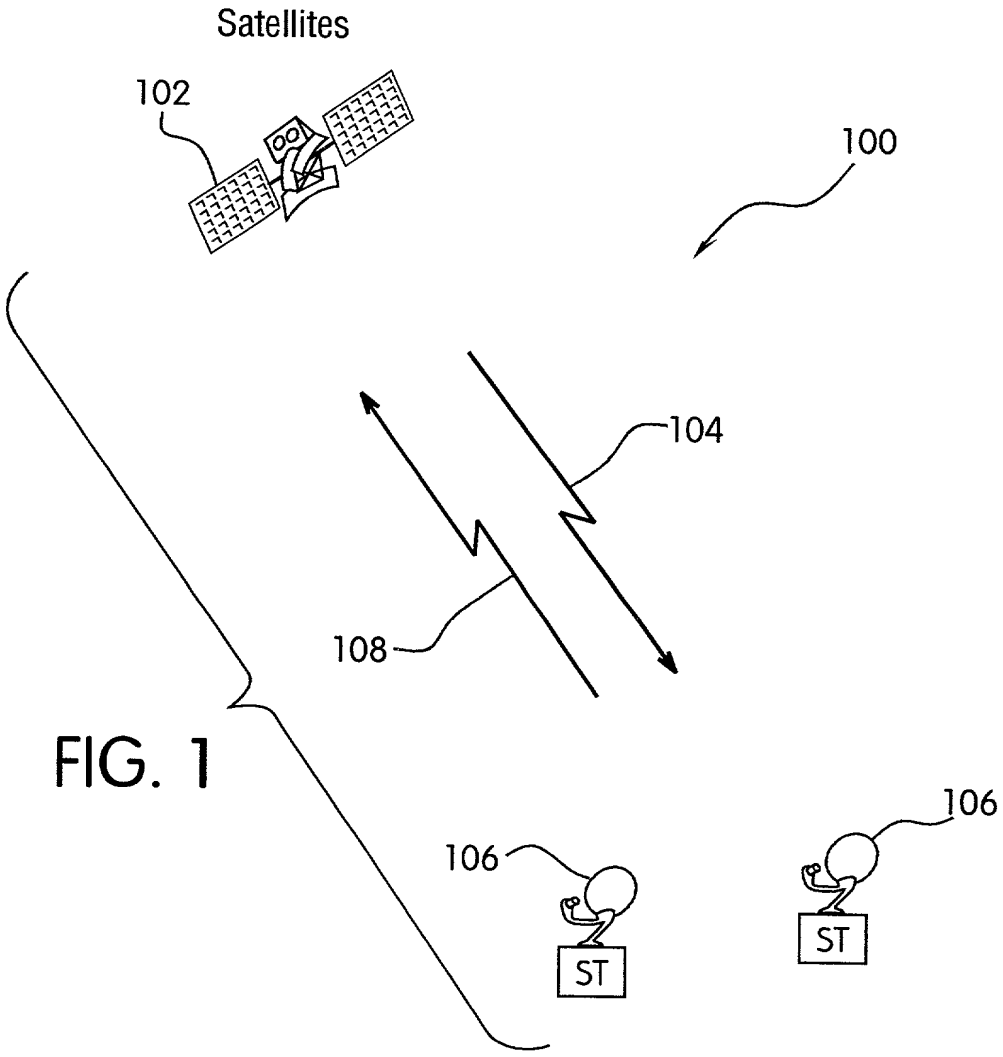


FIG. 1

EP 2 416 496 A2

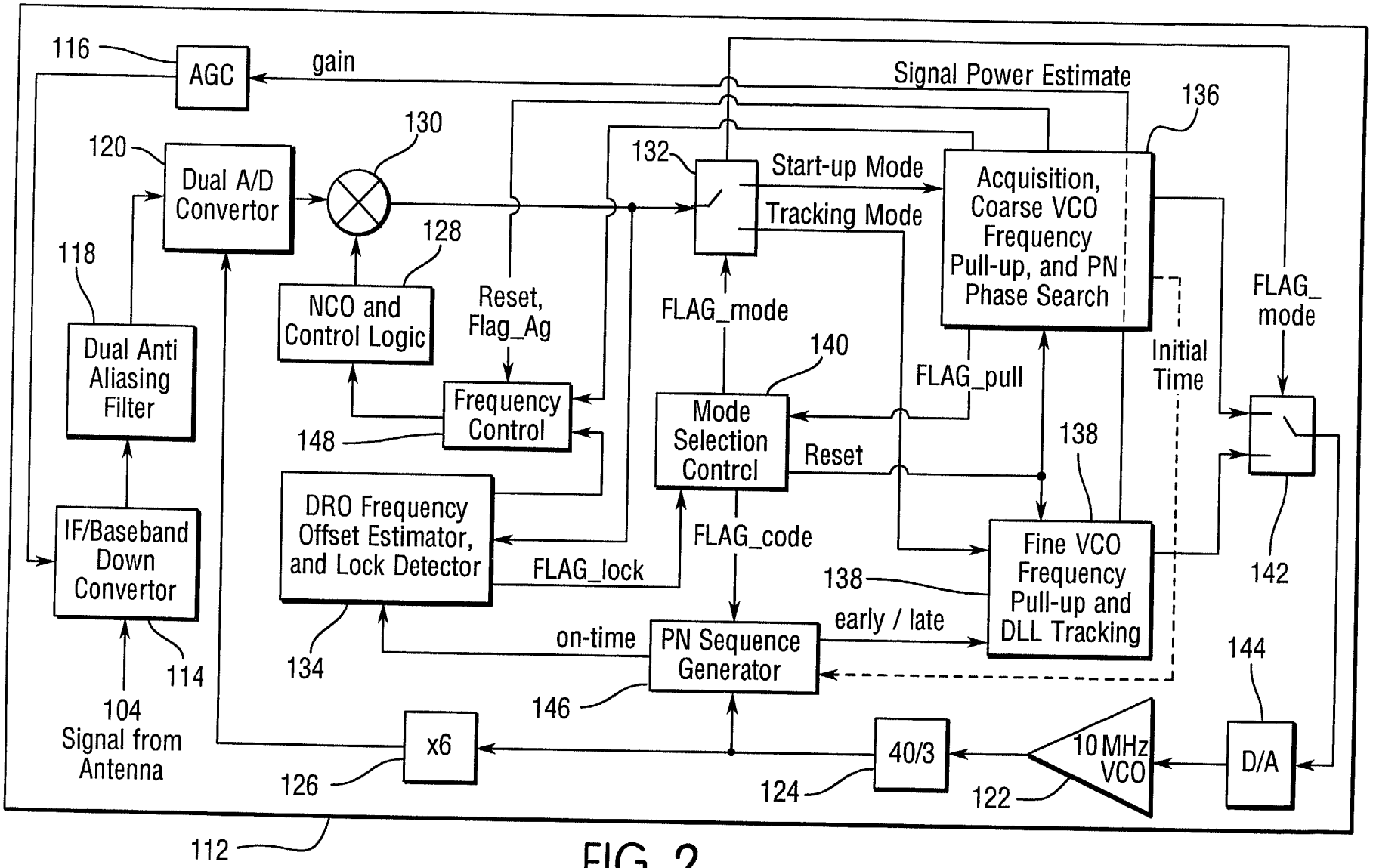

116
AGC
gain
Signal Power Estimate
136
120
Dual A/D Convertor
130
132
Start-up Mode
Tracking Mode
Acquisition, Coarse VCO Frequency Pull-up, and PN Phase Search
118
128
NCO and Control Logic
Reset, Flag_Ag
FLAG_mode
FLAG_ mode
Dual Anti Aliasing Filter
140
Frequency Control
148
Mode Selection Control
FLAG_pull
Initial Time
Reset
138
DRO Frequency Offset Estimator, and Lock Detector
FLAG_code
Fine VCO Frequency Pull-up and DLL Tracking
142
IF/Baseband Down Convertor
FLAG_lock
138
134
on-time
PN Sequence Generator
early / late
144
114
104
Signal from Antenna
146
x6
40/3
10 MHz VCO
D/A
126
124
122
112

FIG. 2

TOHZIO" 92789760

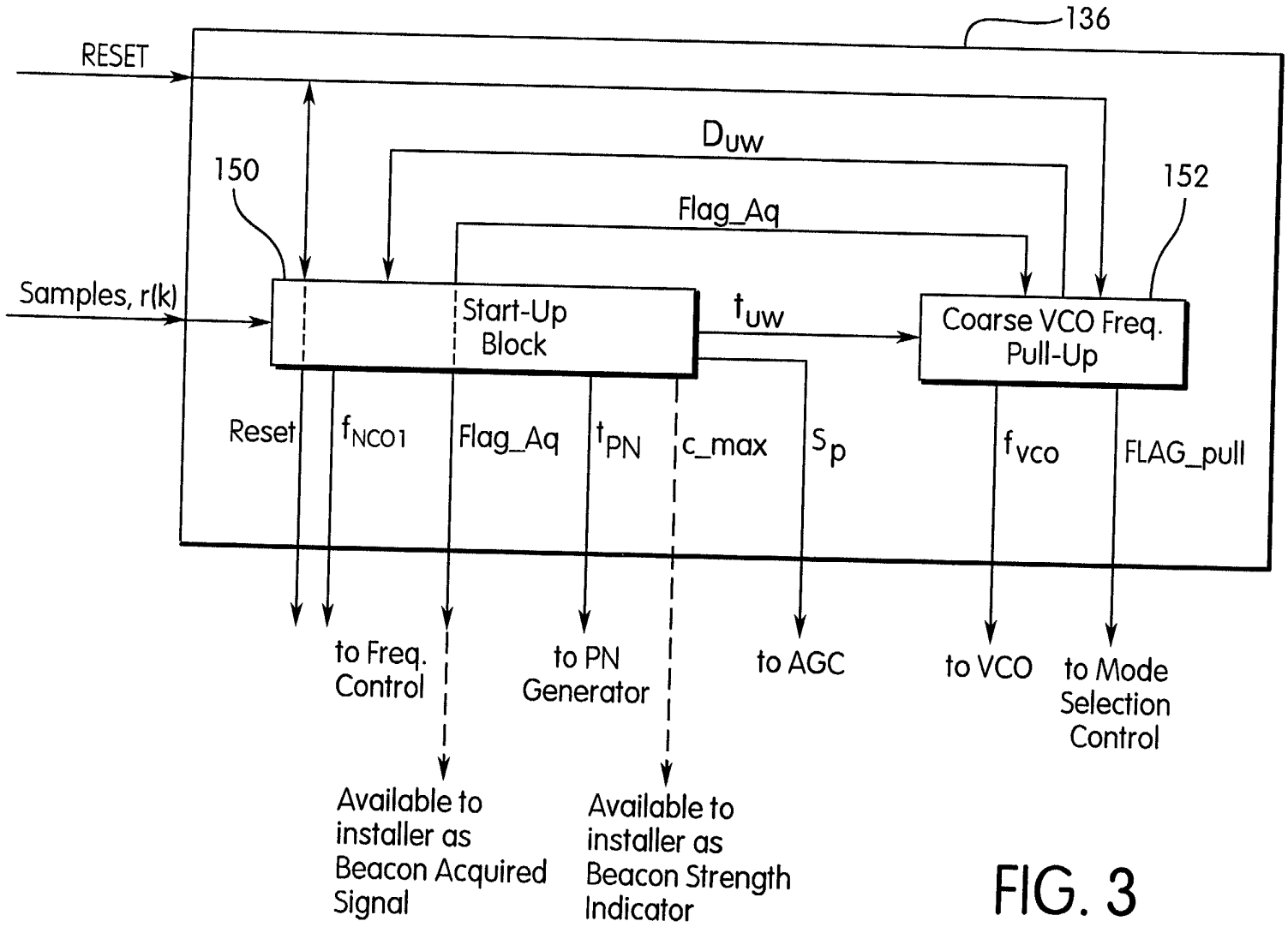


FIG. 3

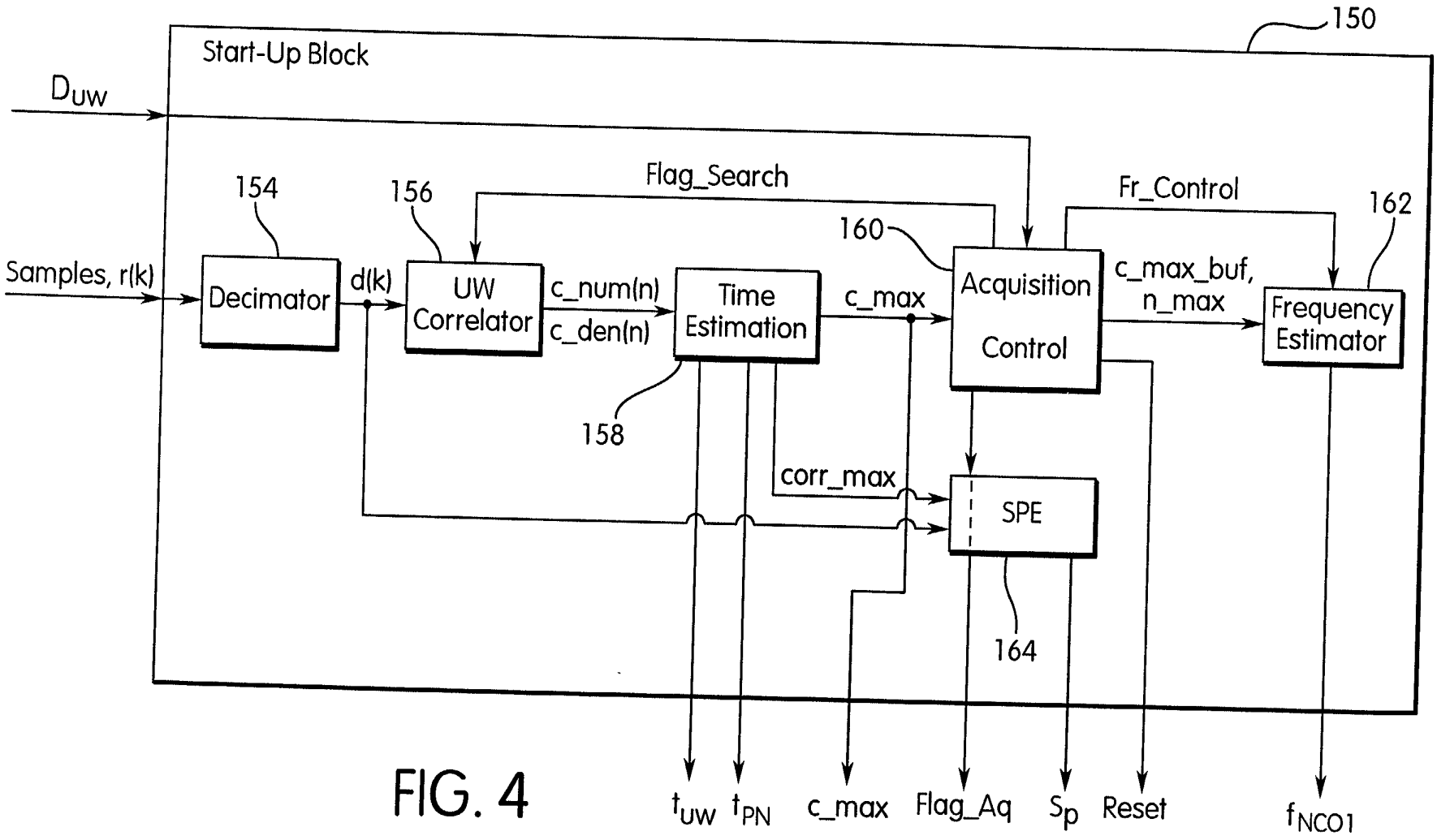

150
Start-Up Block
D_{UW}
Flag_Search
Fr_Control
154
156
160
162
Samples, r(k)
Decimator
d(k)
UW Correlator
c_num(n)
c_den(n)
Time Estimation
c_max
Acquisition Control
c_max_buf, n_max
Frequency Estimator
158
corr_max
SPE
164
t_{UW}
t_{PN}
c_max
Flag_Aq
S_p
Reset
f_{NCO1}

FIG. 4

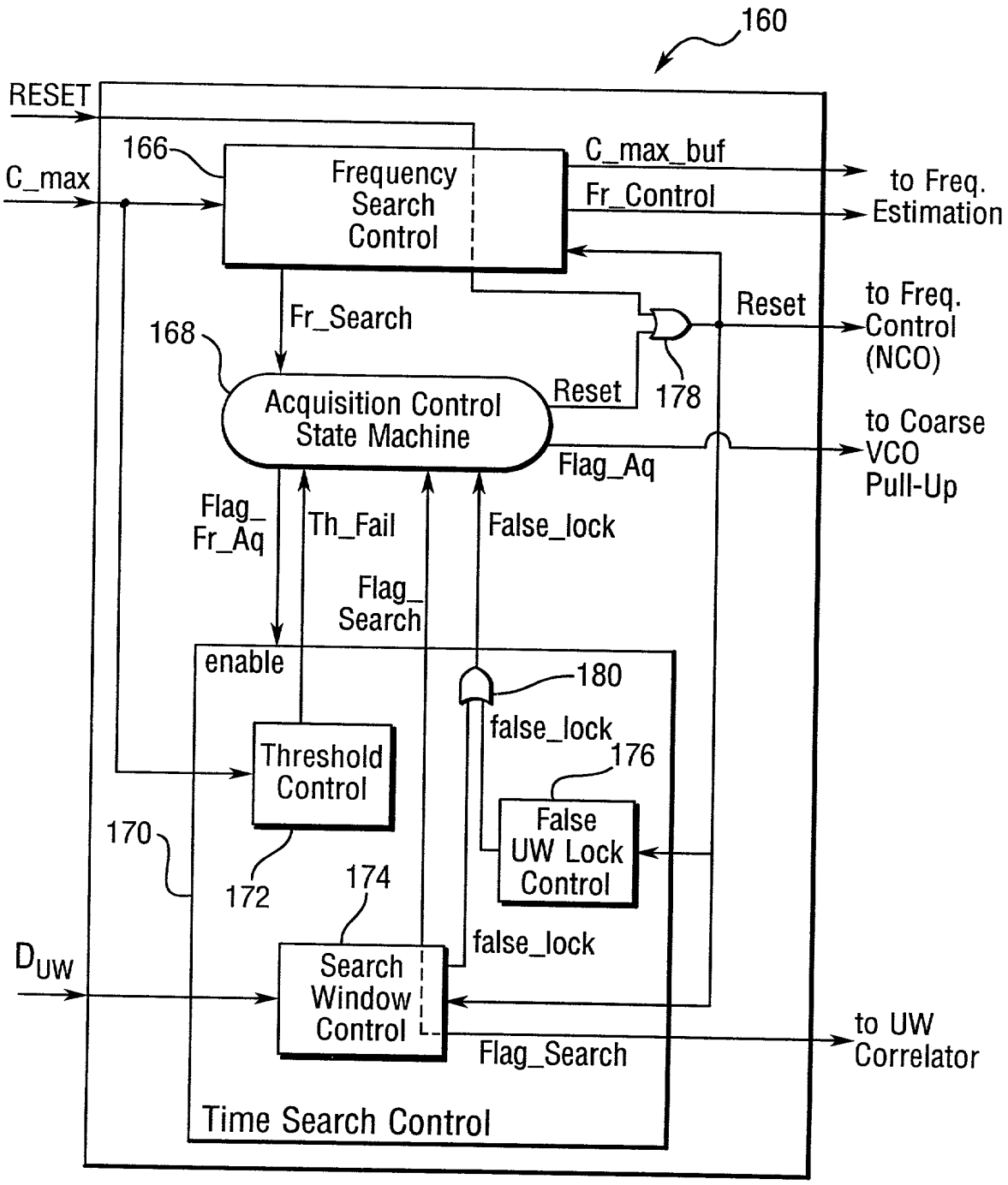

160
RESET
166
C_max
Frequency Search Control
C_max_buf
Fr_Control
to Freq. Estimation
Fr_Search
168
Reset
178
to Freq. Control (NCO)
Acquisition Control State Machine
Reset
Flag_Aq
to Coarse VCO Pull-Up
Flag_ Fr_Aq
Th_Fail
False_lock
Flag_ Search
enable
180
false_lock
Threshold Control
176
False UW Lock Control
170
172
174
false_lock
D_{UW}
Search Window Control
to UW Correlator
Flag_Search
Time Search Control

FIG. 5

TOh2TO" 92289260

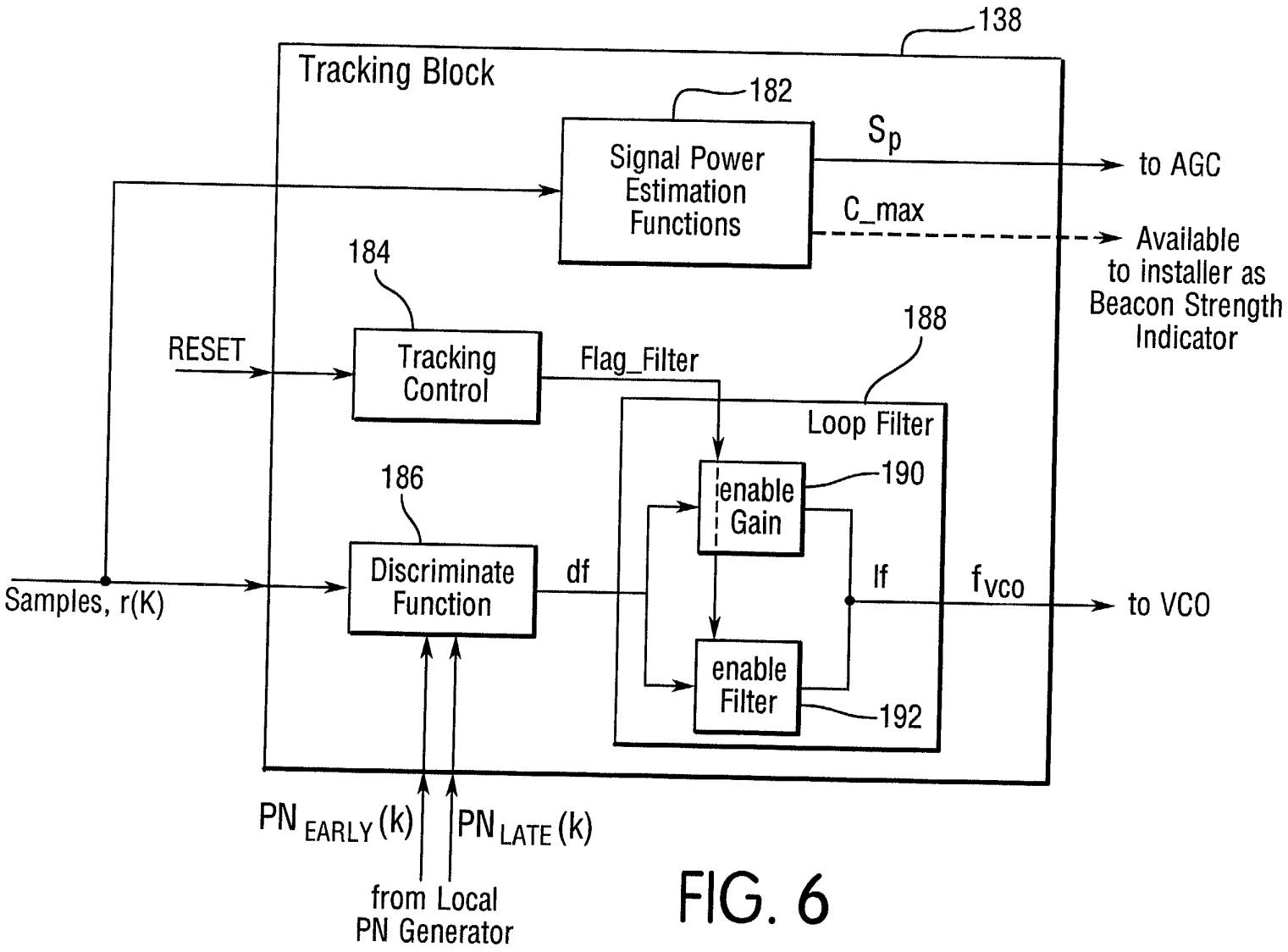


FIG. 6

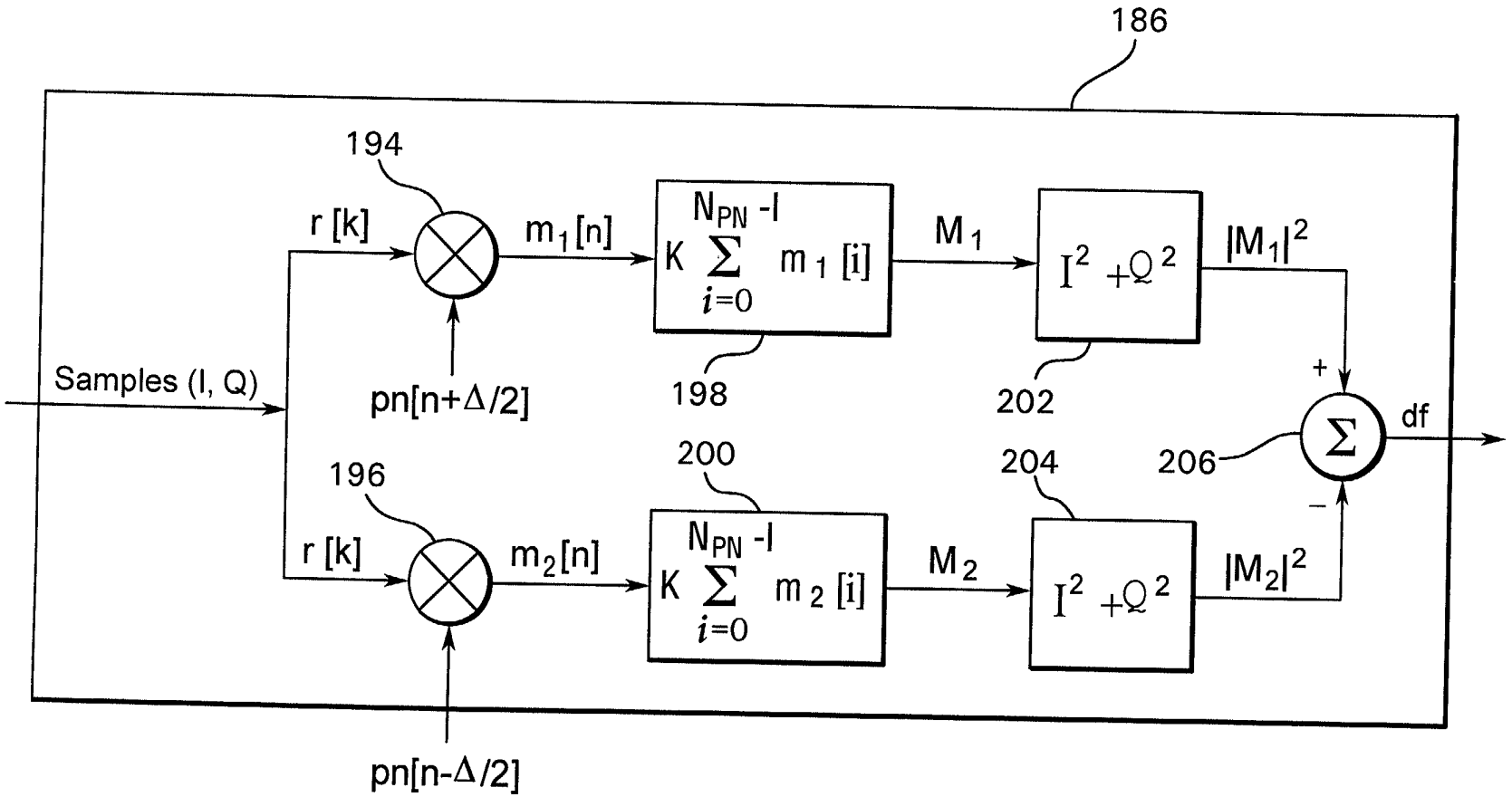

186
194
r [k]
$m_1[n]$
$K \sum_{i=0}^{N_{PN}-1} m_1[i]$
M_1
$I^2 + Q^2$
$|M_1|^2$
Samples (I, Q)
pn[n+Δ/2]
198
202
+
df
206
200
204
196
r [k]
$m_2[n]$
$K \sum_{i=0}^{N_{PN}-1} m_2[i]$
M_2
$I^2 + Q^2$
$|M_2|^2$
−
pn[n-Δ/2]

FIG. 7

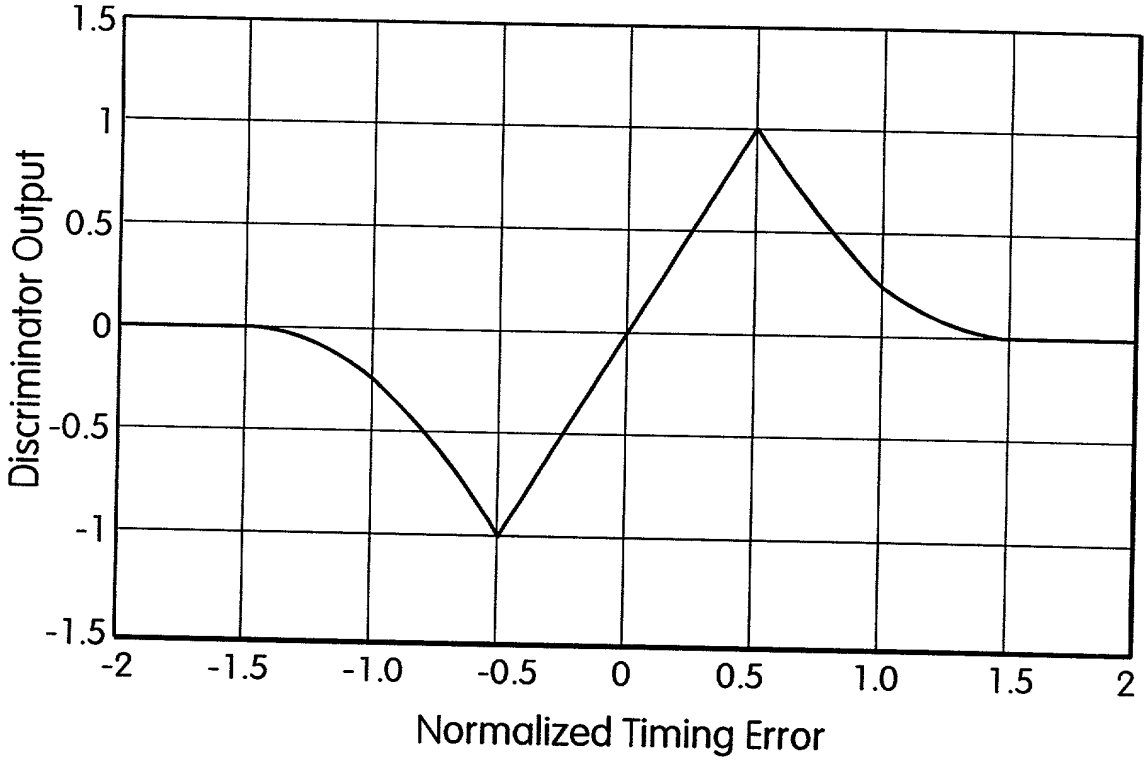

1.5
1
0.5
0
-0.5
-1
-1.5
Discriminator Output
-2
-1.5
-1.0
-0.5
0
0.5
1.0
1.5
2
Normalized Timing Error

FIG. 8

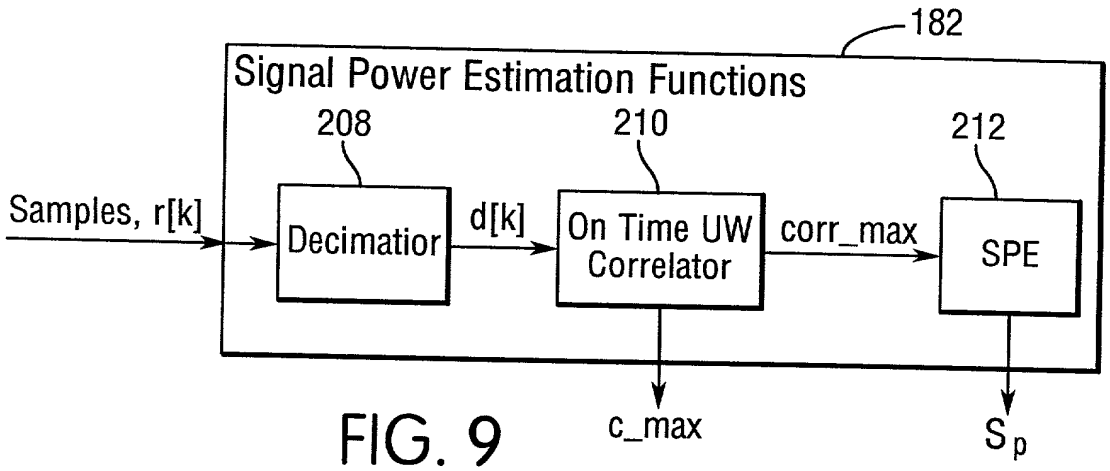


FIG. 9

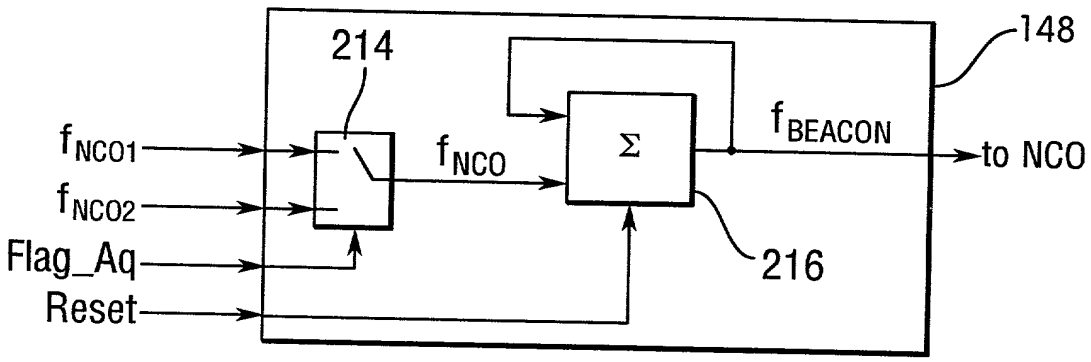
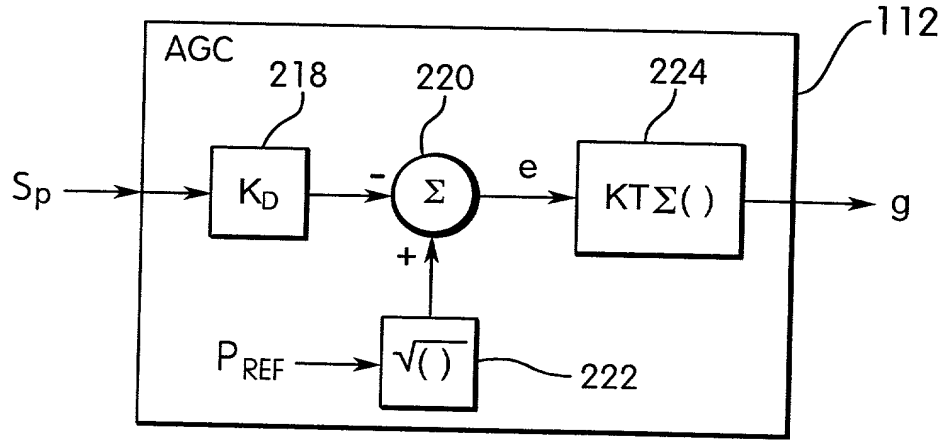


FIG. 10



AGC Block Diagram

FIG. 11

T0h2T0" 92789760

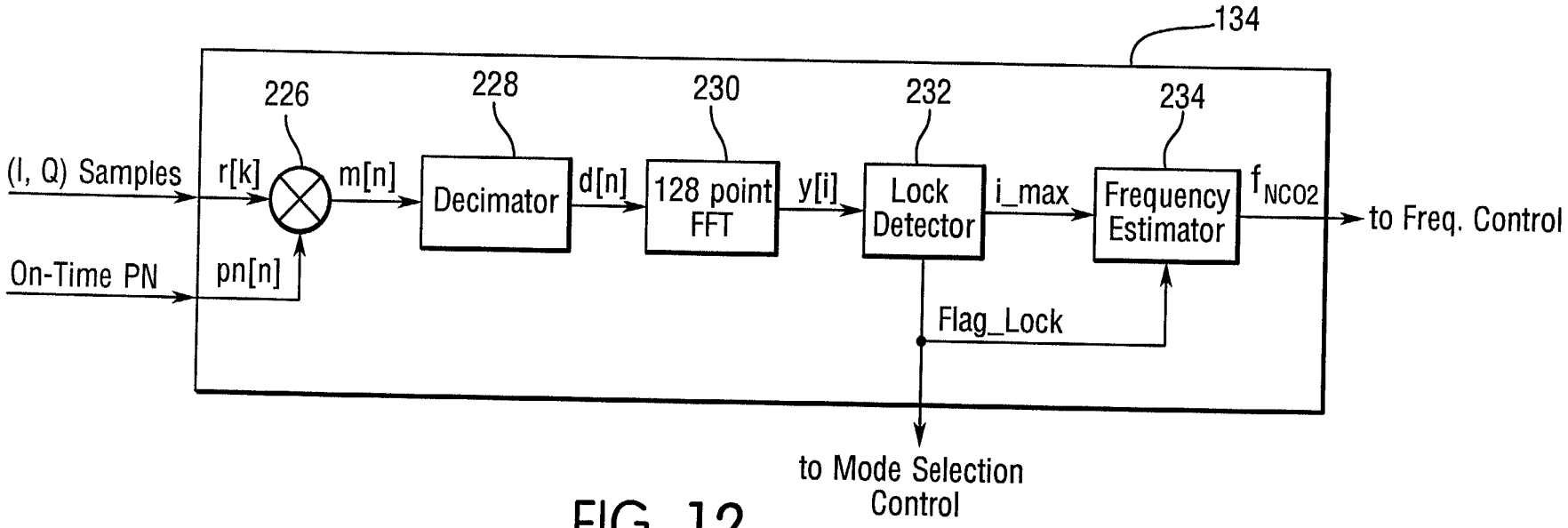


FIG. 12

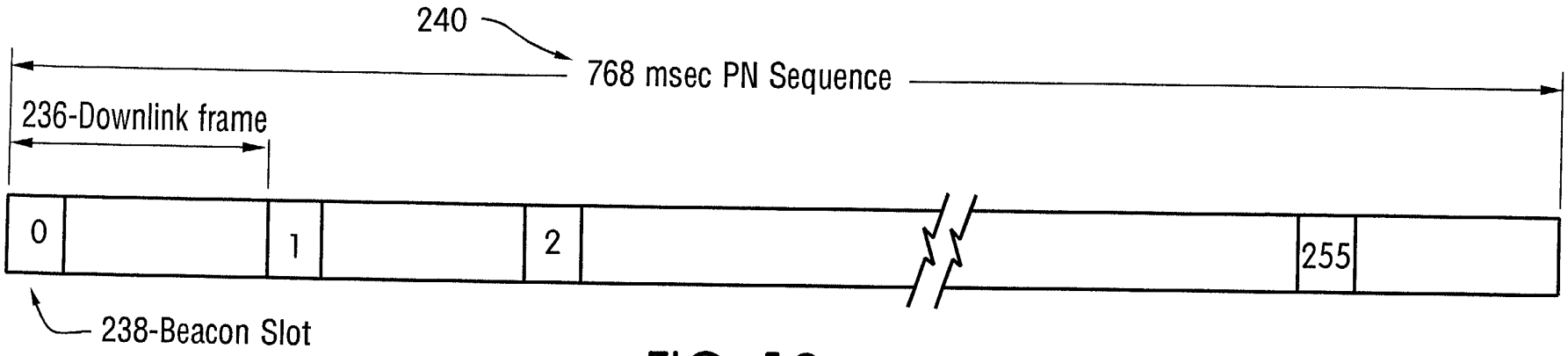

240
768 msec PN Sequence
236-Downlink frame
0
1
2
255
238-Beacon Slot

FIG. 13

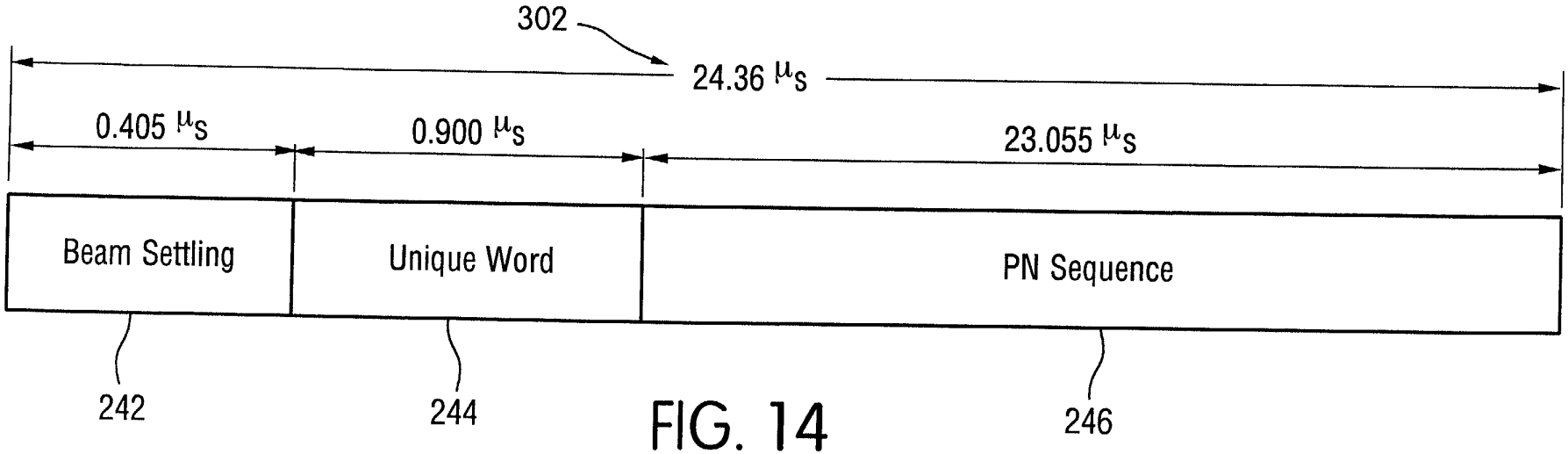

302
24.36 μs
0.405 μs
0.900 μs
23.055 μs
Beam Settling
Unique Word
PN Sequence
242
244
246

FIG. 14

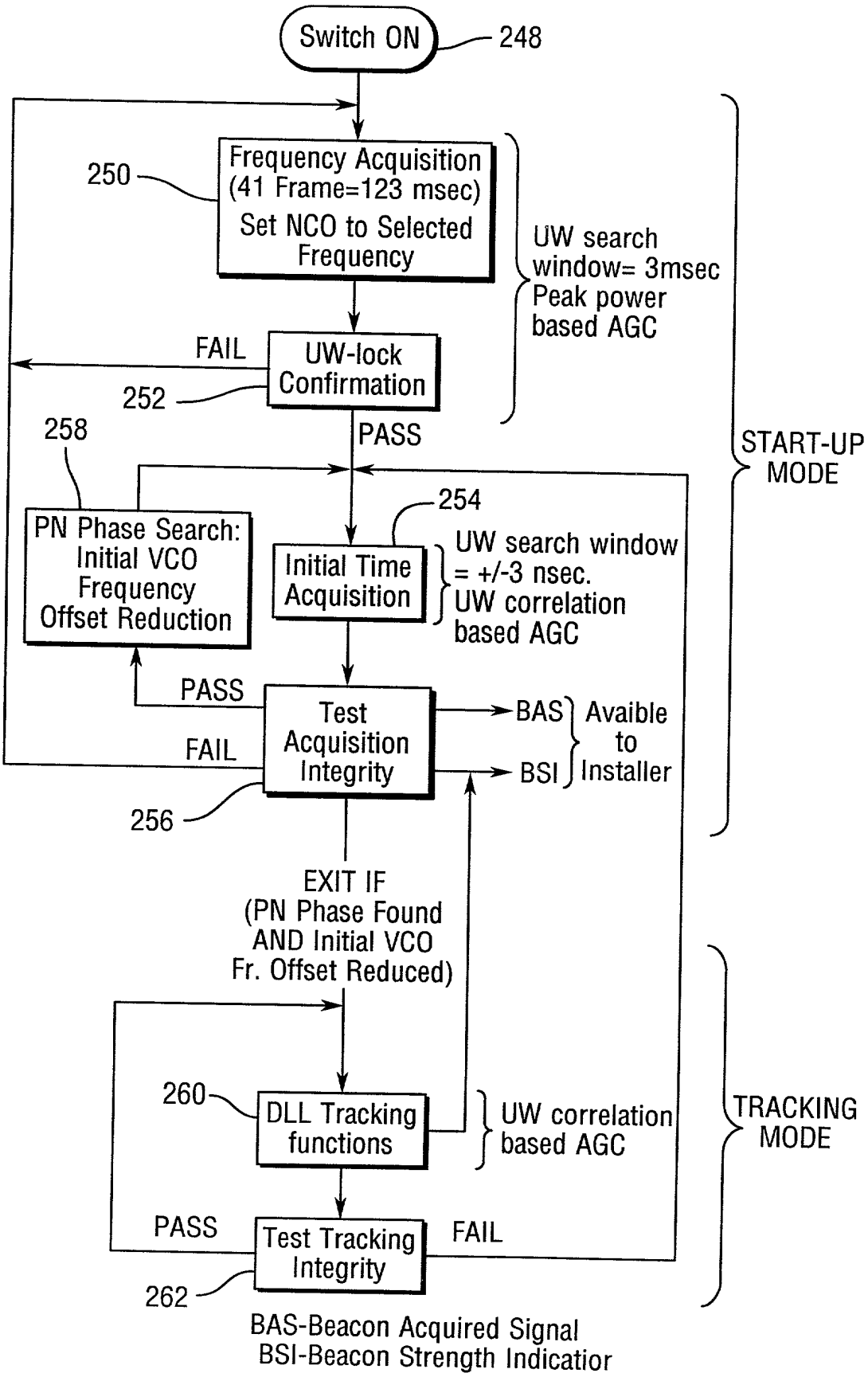

Switch ON
248
Frequency Acquisition
(41 Frame=123 msec)
Set NCO to Selected Frequency
250
UW search window= 3msec
Peak power based AGC
FAIL
UW-lock Confirmation
252
PASS
START-UP MODE
258
PN Phase Search: Initial VCO Frequency Offset Reduction
254
Initial Time Acquisition
UW search window = +/-3 nsec.
UW correlation based AGC
PASS
Test Acquisition Integrity
BAS
BSI
Avaible to Installer
FAIL
256
EXIT IF
(PN Phase Found
AND Initial VCO
Fr. Offset Reduced)
260
DLL Tracking functions
UW correlation based AGC
TRACKING MODE
PASS
Test Tracking Integrity
FAIL
262
BAS-Beacon Acquired Signal
BSI-Beacon Strength Indicatior

FIG. 15

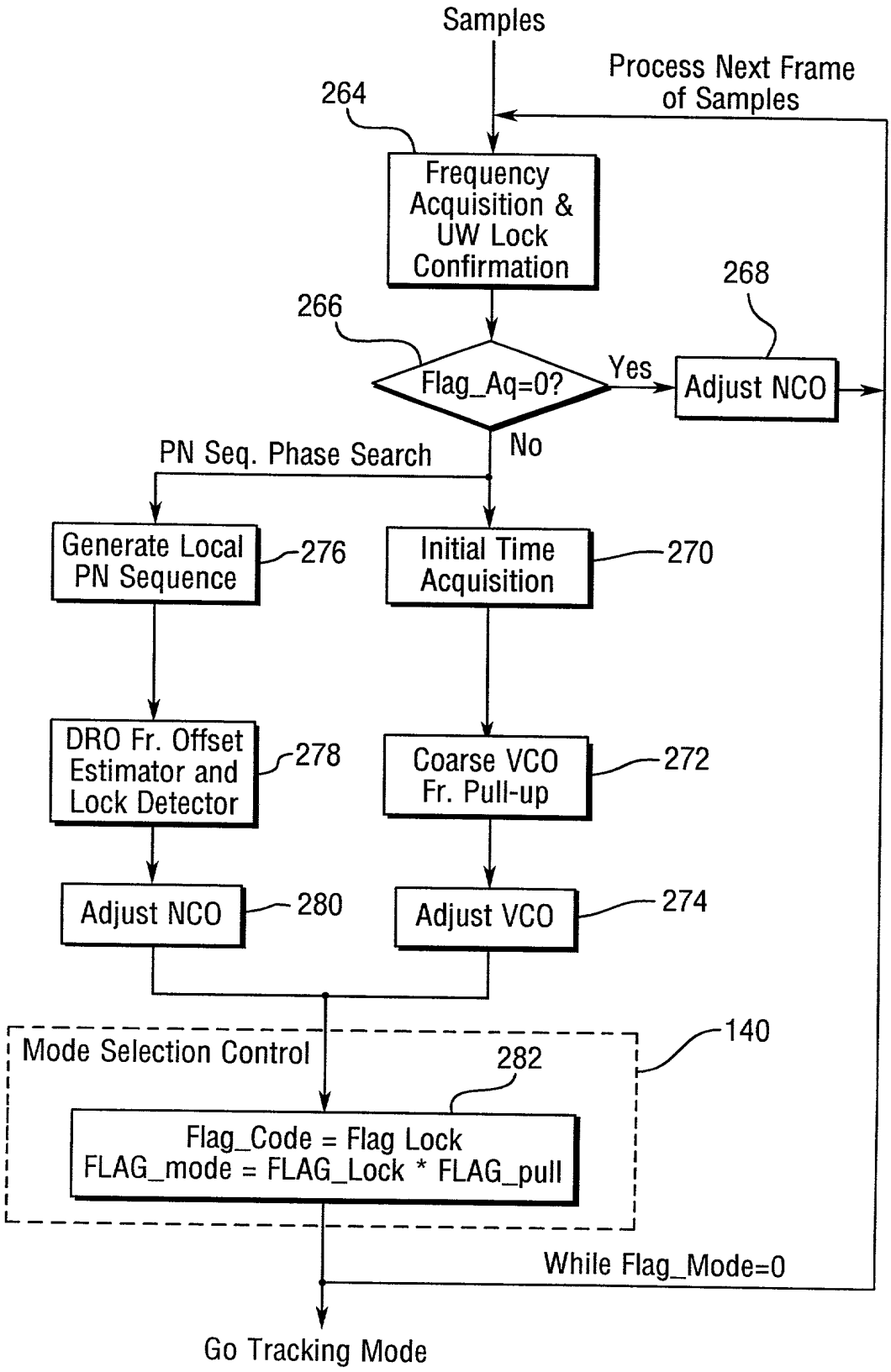

Samples
Process Next Frame of Samples
264
Frequency Acquisition & UW Lock Confirmation
268
266
Flag_Aq=0?
Yes
Adjust NCO
No
PN Seq. Phase Search
Generate Local PN Sequence
276
Initial Time Acquisition
270
DRO Fr. Offset Estimator and Lock Detector
278
Coarse VCO Fr. Pull-up
272
Adjust NCO
280
Adjust VCO
274
Mode Selection Control
140
282
Flag_Code = Flag Lock
FLAG_mode = FLAG_Lock * FLAG_pull
While Flag_Mode=0
Go Tracking Mode

FIG. 16

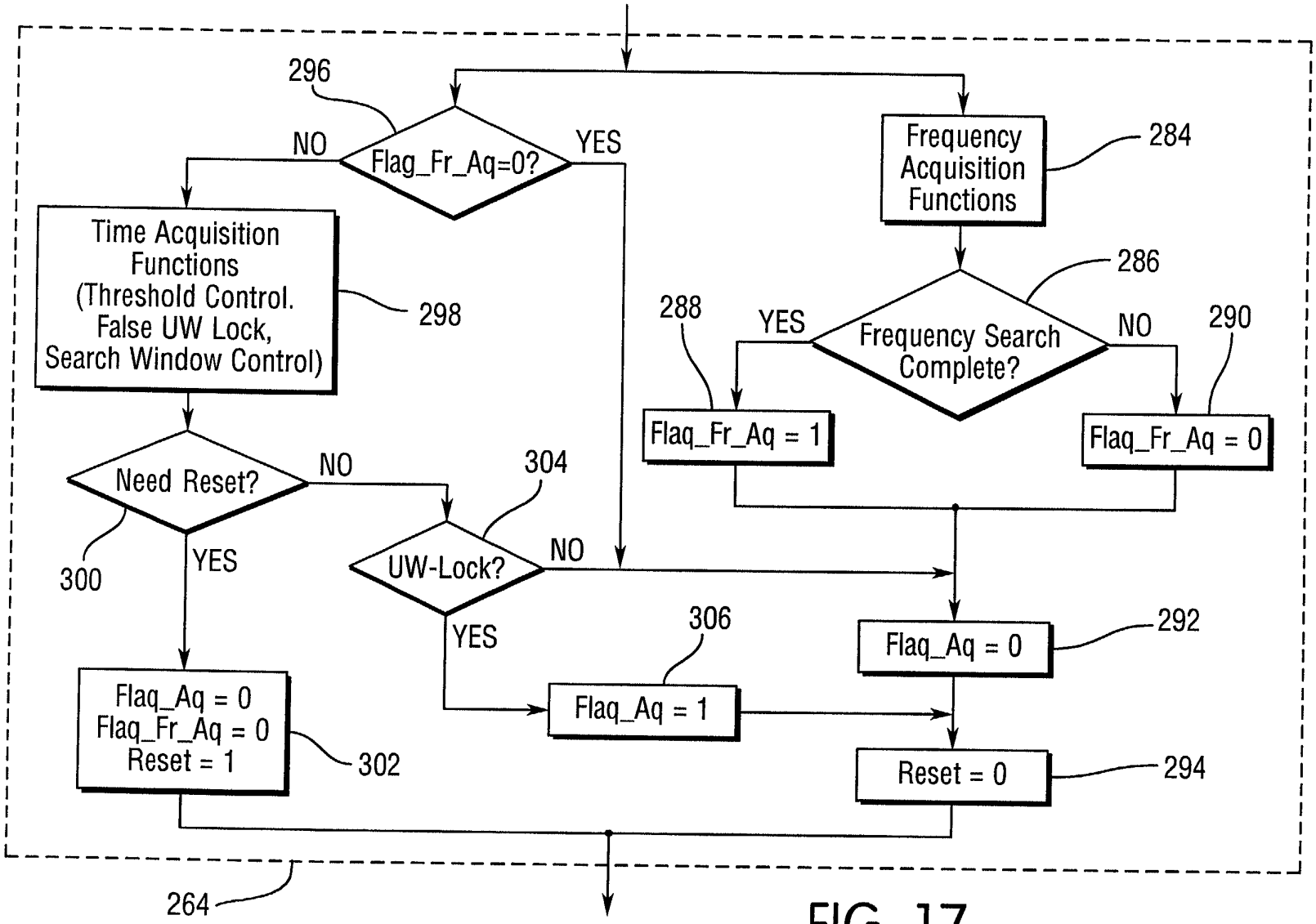

296
Flag_Fr_Aq=0?
NO
YES
Time Acquisition Functions (Threshold Control. False UW Lock, Search Window Control)
298
Frequency Acquisition Functions
284
286
Frequency Search Complete?
288
YES
NO
290
Flaq_Fr_Aq = 1
Flaq_Fr_Aq = 0
Need Reset?
NO
304
300
YES
UW-Lock?
NO
YES
306
Flaq_Aq = 0
292
Flaq_Aq = 0
Flaq_Fr_Aq = 0
Reset = 1
302
Flaq_Aq = 1
Reset = 0
294
264

FIG. 17

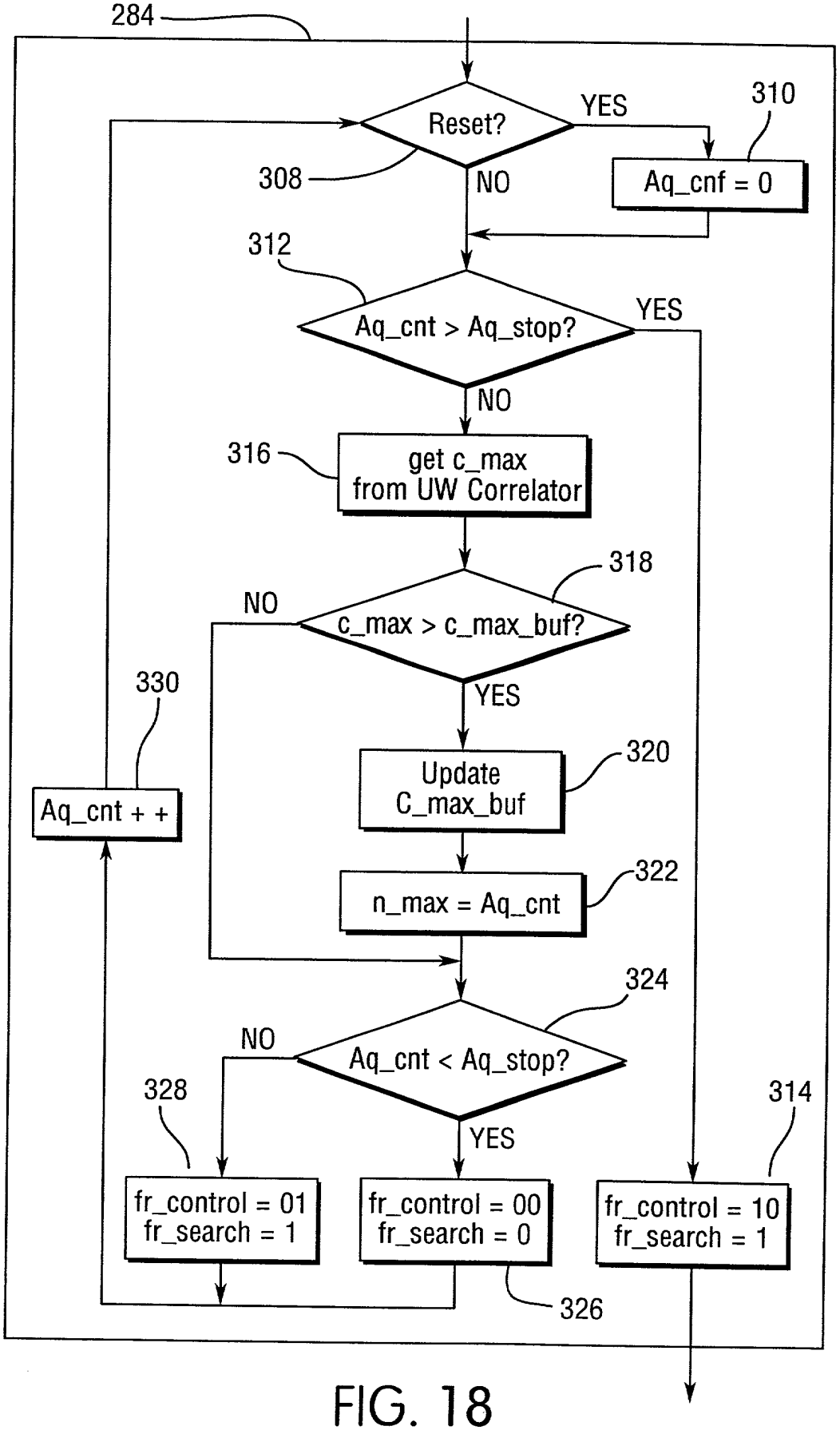

284
Reset?
YES
310
308
NO
Aq_cnf = 0
312
Aq_cnt > Aq_stop?
YES
NO
316
get c_max
from UW Correlator
318
NO
c_max > c_max_buf?
YES
330
320
Update
C_max_buf
Aq_cnt + +
322
n_max = Aq_cnt
324
NO
Aq_cnt < Aq_stop?
328
314
YES
fr_control = 01
fr_search = 1
fr_control = 00
fr_search = 0
fr_control = 10
fr_search = 1
326

FIG. 18

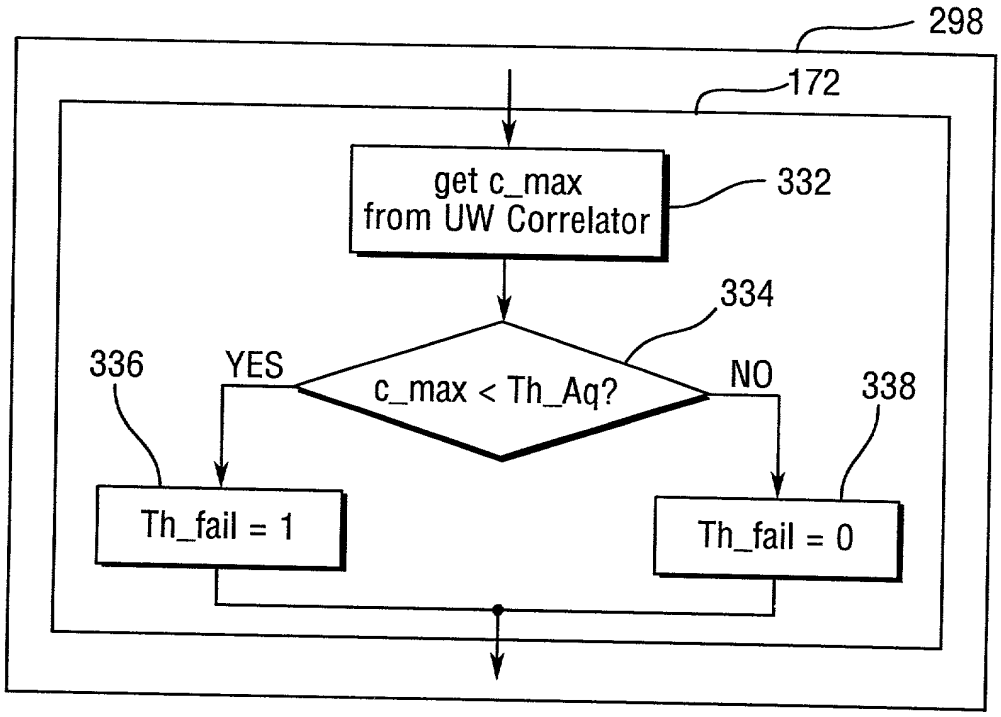

298
172
get c_max
from UW Correlator
332
334
336
YES
c_max < Th_Aq?
NO
338
Th_fail = 1
Th_fail = 0

FIG. 19

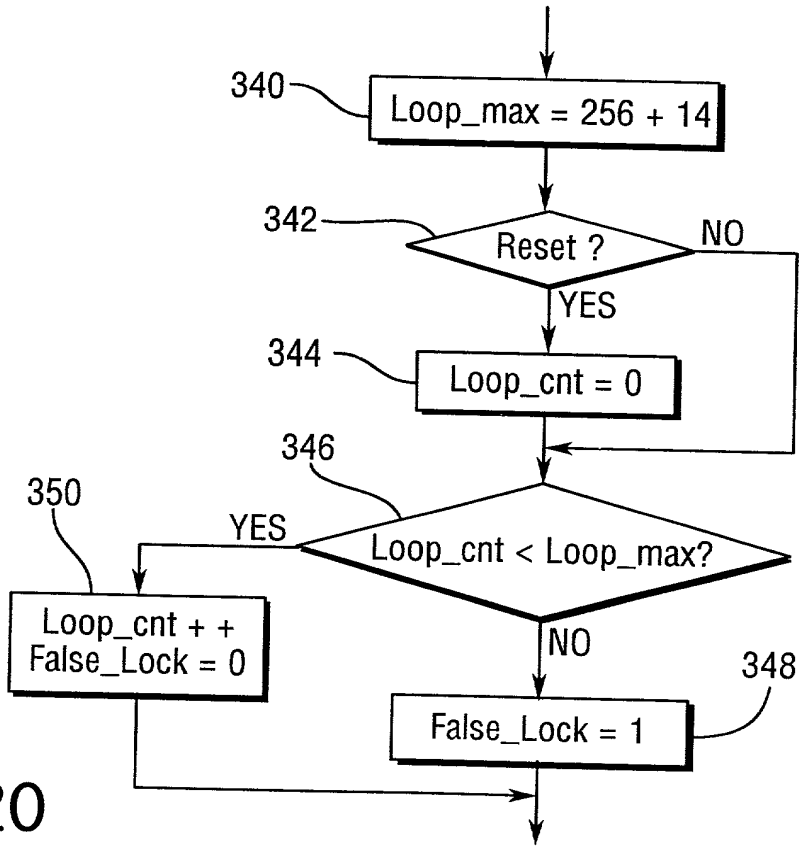

340
Loop_max = 256 + 14
342
Reset ?
NO
YES
344
Loop_cnt = 0
346
350
YES
Loop_cnt < Loop_max?
Loop_cnt + +
False_Lock = 0
NO
348
False_Lock = 1

FIG. 20

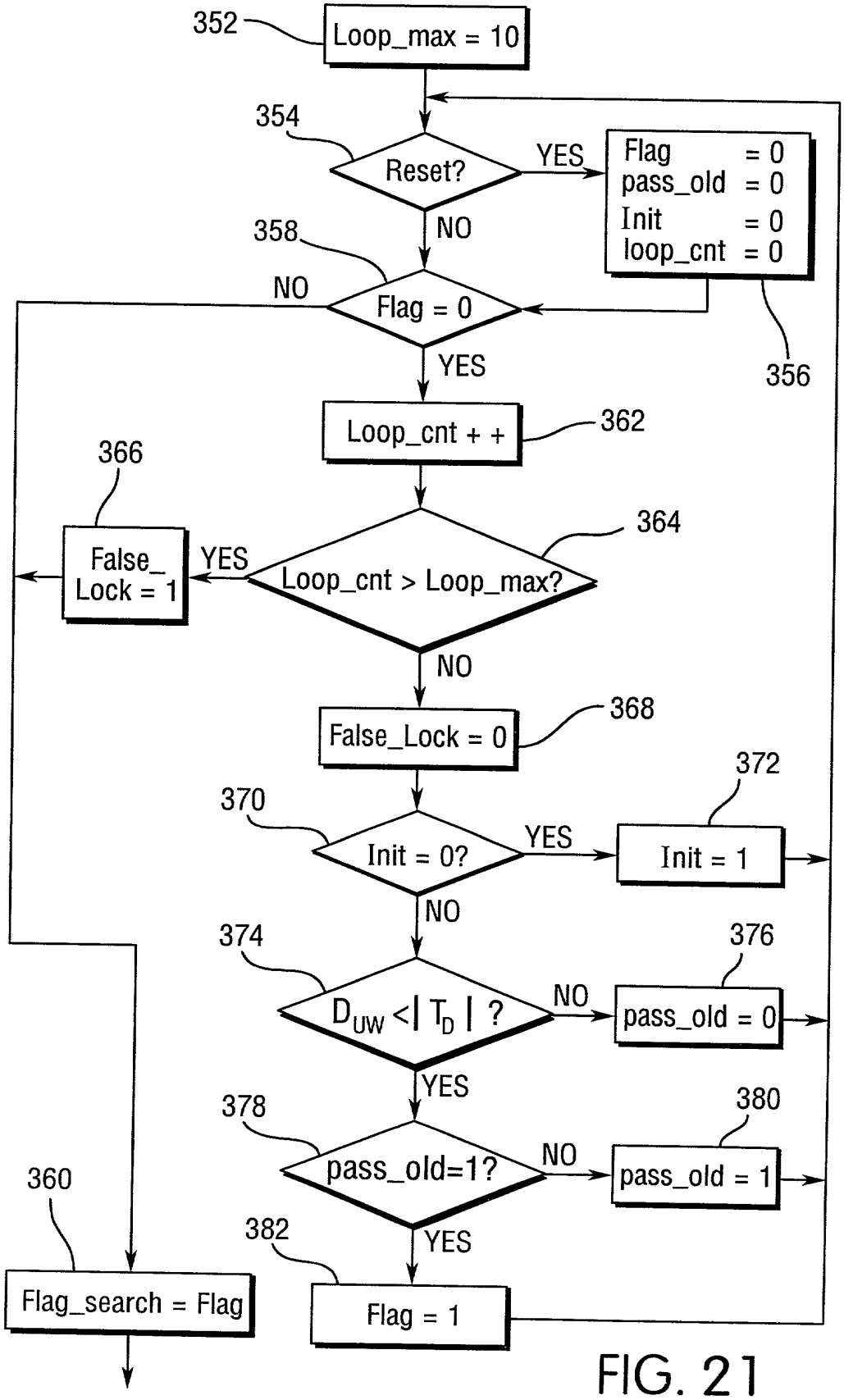

352
Loop_max = 10
354
Reset?
YES
Flag = 0
pass_old = 0
Init = 0
loop_cnt = 0
NO
358
NO
Flag = 0
356
YES
Loop_cnt + +
362
366
364
False_
Lock = 1
YES
Loop_cnt > Loop_max?
NO
368
False_Lock = 0
372
370
Init = 0?
YES
Init = 1
NO
374
376
$D_{UW} < | T_D |$?
NO
pass_old = 0
YES
378
380
pass_old=1?
NO
pass_old = 1
360
382
YES
Flag_search = Flag
Flag = 1

FIG. 21

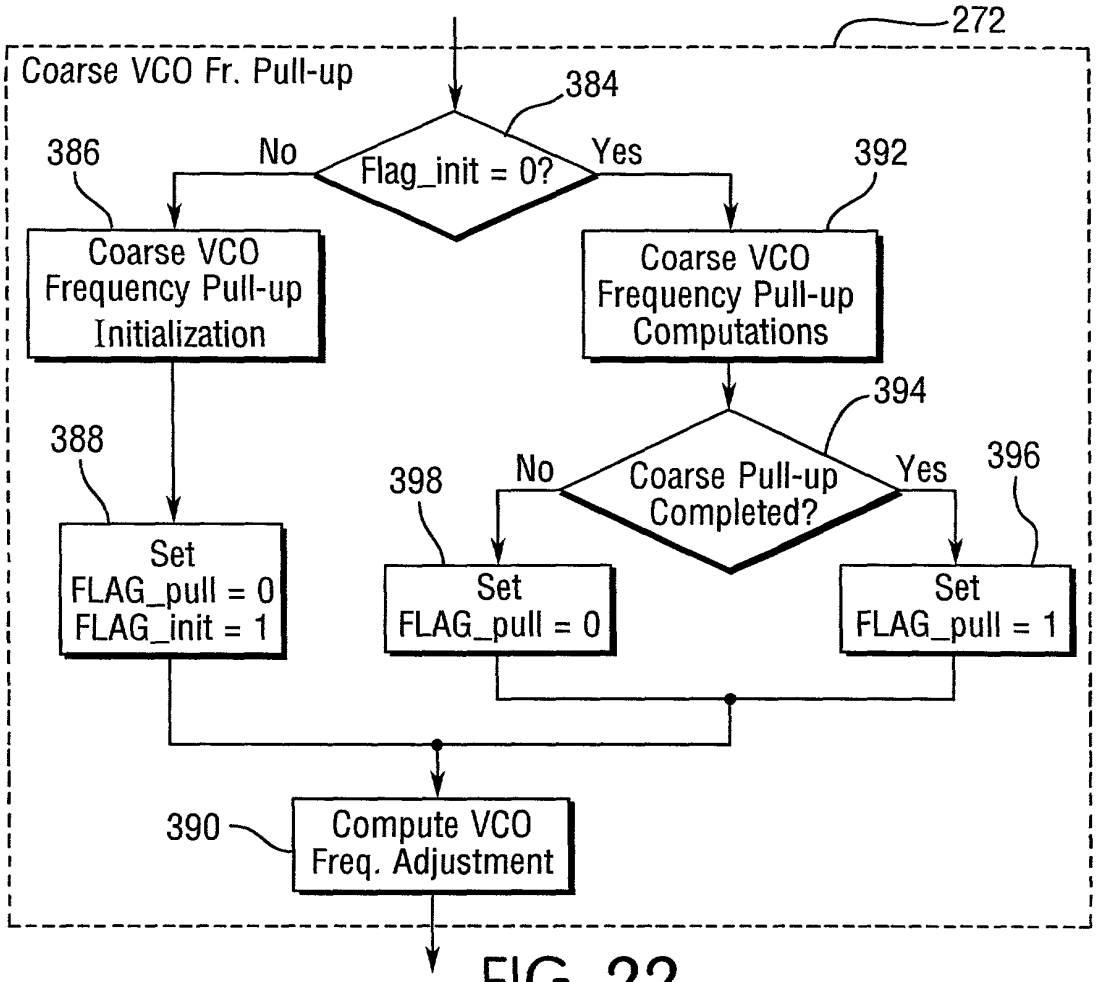

272
Coarse VCO Fr. Pull-up
384
386
No
Flag_init = 0?
Yes
392
Coarse VCO Frequency Pull-up Initialization
Coarse VCO Frequency Pull-up Computations
394
388
398
No
Coarse Pull-up Completed?
Yes
396
Set FLAG_pull = 0 FLAG_init = 1
Set FLAG_pull = 0
Set FLAG_pull = 1
390
Compute VCO Freq. Adjustment

FIG. 22

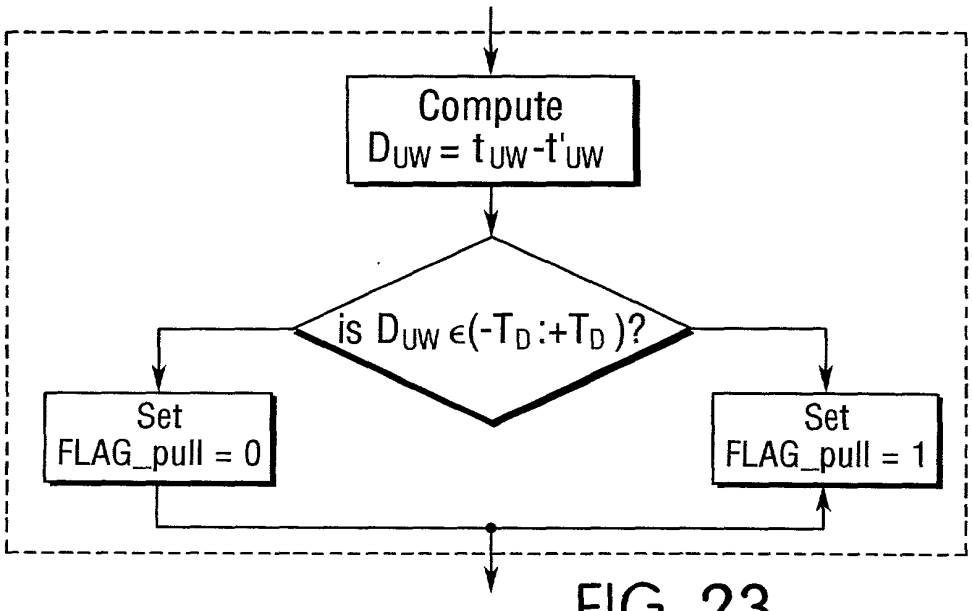
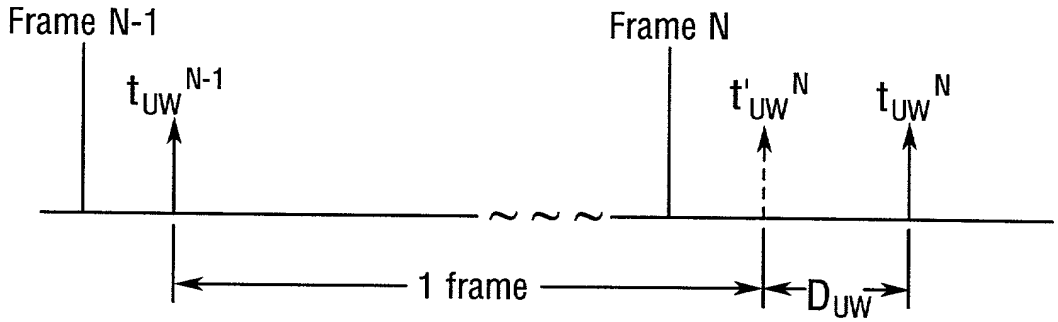

Compute $D_{UW} = t_{UW} - t'_{UW}$
is $D_{UW} \in (-T_D : +T_D)$?
Set FLAG_pull = 0
Set FLAG_pull = 1

FIG. 23



t_{UW}^{N}=detected UW reference in frame N.

FIG. 24

Exhibit 1019, page 59 of 59

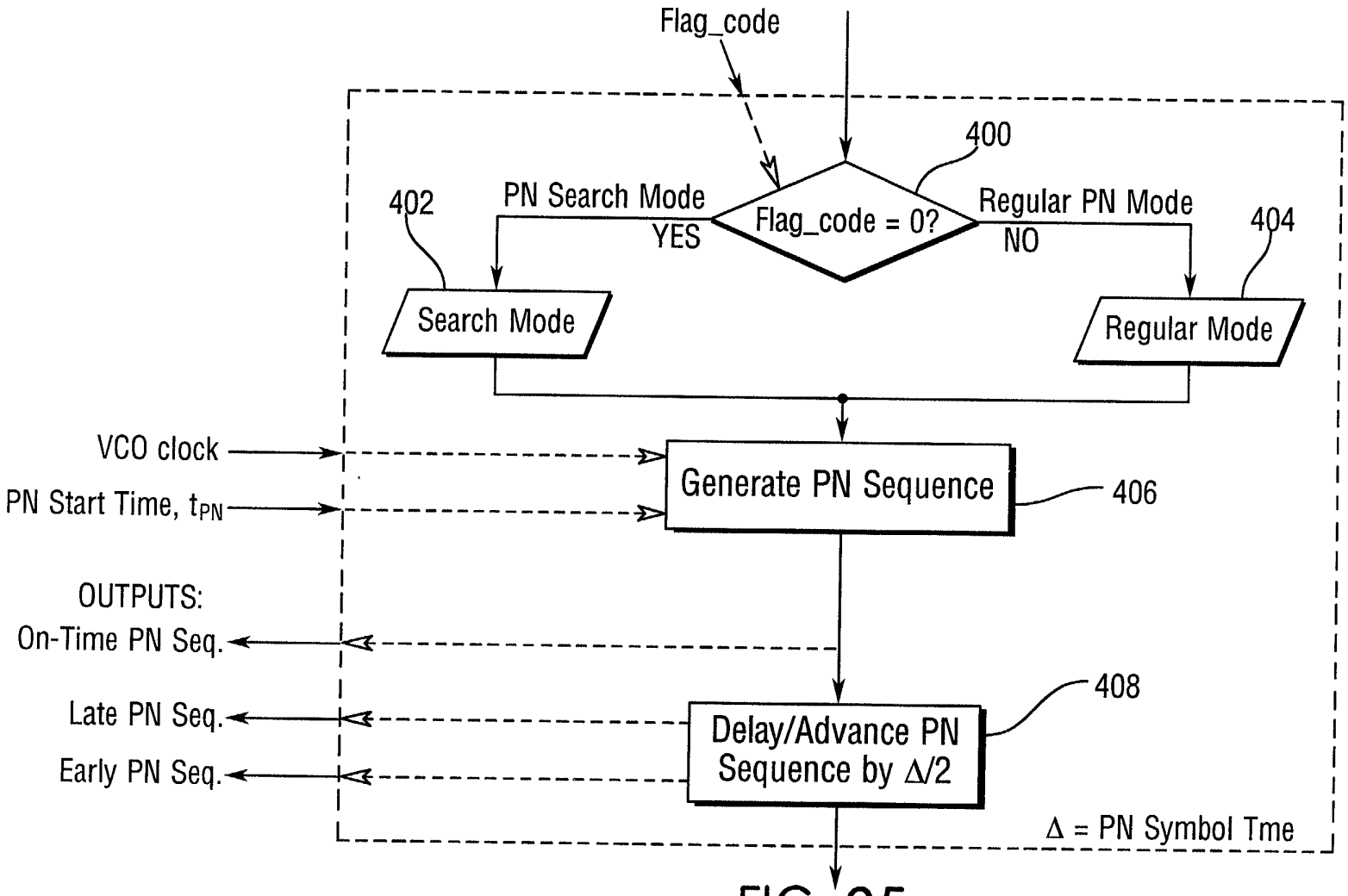

Flag_code
400
402
PN Search Mode
YES
Flag_code = 0?
Regular PN Mode
NO
404
Search Mode
Regular Mode
VCO clock
PN Start Time, t_{PN}
Generate PN Sequence
406
OUTPUTS:
On-Time PN Seq.
Late PN Seq.
Early PN Seq.
408
Delay/Advance PN Sequence by Δ/2
Δ = PN Symbol Tme

FIG. 25

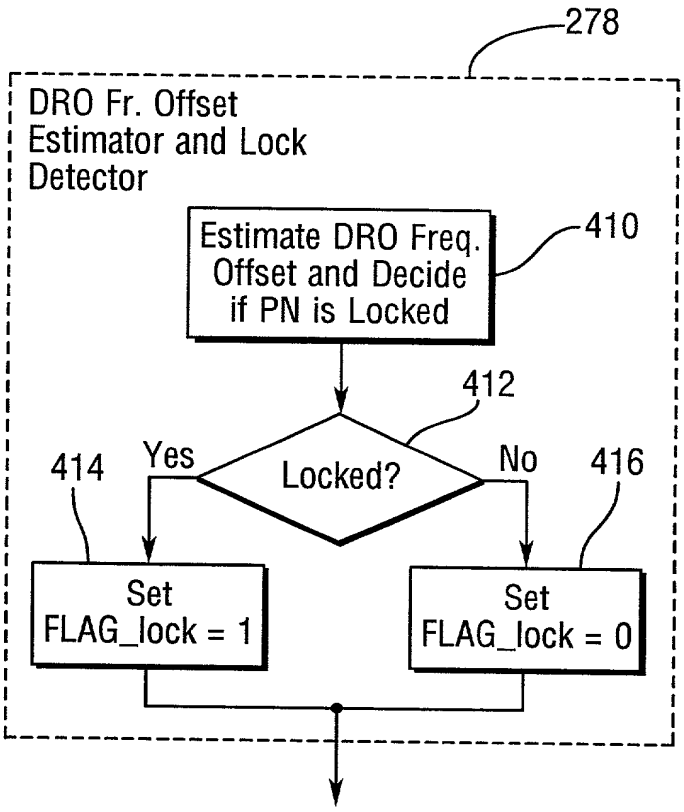

278
DRO Fr. Offset
Estimator and Lock
Detector
Estimate DRO Freq.
Offset and Decide
if PN is Locked
410
412
Locked?
Yes
No
414
416
Set
FLAG_lock = 1
Set
FLAG_lock = 0

FIG. 26

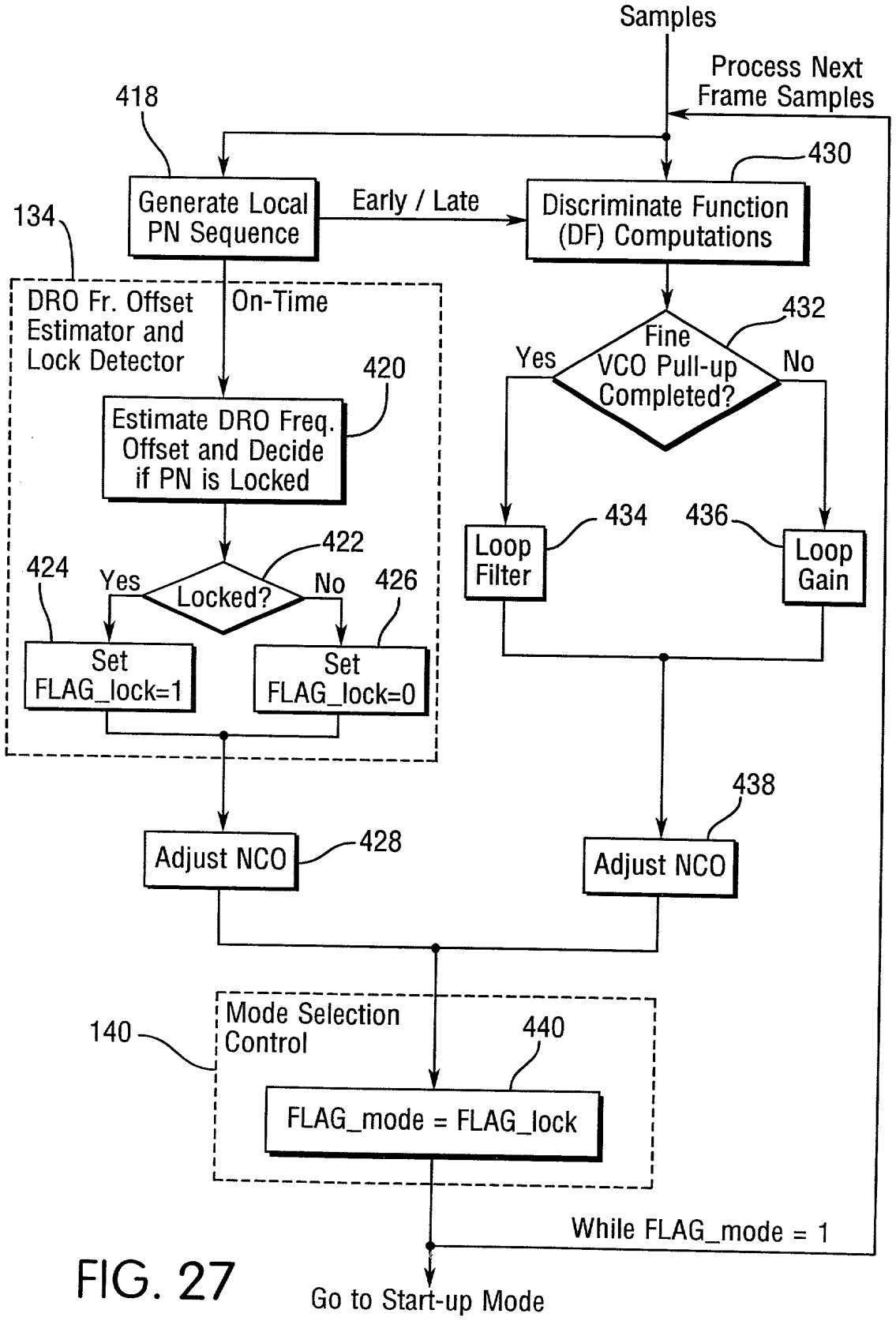

Samples
Process Next Frame Samples
418
430
Generate Local PN Sequence
Early / Late
Discriminate Function (DF) Computations
134
DRO Fr. Offset Estimator and Lock Detector
On-Time
432
Fine VCO Pull-up Completed?
Yes
No
420
Estimate DRO Freq. Offset and Decide if PN is Locked
422
424
Yes
Locked?
No
426
434
436
Loop Filter
Loop Gain
Set FLAG_lock=1
Set FLAG_lock=0
438
Adjust NCO
428
Adjust NCO
Mode Selection Control
140
440
FLAG_mode = FLAG_lock
While FLAG_mode = 1
Go to Start-up Mode

FIG. 27